Nova Notes

The Newsletter of the Halifax Centre of the Royal Astronomical Society of Canada

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In this issue:

Front Page Photo: Dave Chapman
Milky Way and Magellanic clouds.

The southern sky, taken from Mount Cook Alpine Village, New Zealand

Details on page 3

From the editor *Quinn Smith*

As this edition goes to press, the Sun has just crossed the equator and is heading toward the northern tropic. It is also currently awakening from its recent extreme low point in its cycle. There is no connection between the two but check out Cosmic Debris anyway (page 11).

The spring is my favourite time for astronomy. The nights are warmer, but still dark for long periods. There are no bugs, and for those of us who love to chase down the "faint fuzzies", this is the time for Messier Marathons. Well maybe a little late (March is a better month) but April is still my favourite month.

It is also a time to plan our spring and summer Outreach activities. In late April and early May we have a public Outreach event at the Salt-Scapes show (in conjunction with Atlantic Photo Supply). A week later it is Astronomy Week (May 2nd to 8th) culminating in Astronomy Day (May 7th).

And of course later in the Summer our very own Nova East (see page 3). Bring it on!.

St Croix Observatory

Part of your membership in the Halifax RASC includes access to our observatory, located in the community of St. Croix, NS. The site has grown over the last few years to include a roll-off roof observatory with electrical outlets, a warm-room and washroom facilities.

Enjoy dark pristine skies far away from city lights, and the company of like minded observers searching out those faint "fuzzies" in the night. Observing nights (Fridays close to the New Moon) are open to members and guests.

If you are not a key holder and would like to become one, or need more information please contact the Observing Chairman, John Liddard (see below).

Upcoming Observing Nights:

May	6th	2011
June	3rd	2011
July	1st	2011

Meetings begin at 8 p.m. at Saint Mary's University
Our usual room is AT 101 however during the exam period there will be room changes (see meeting notes below)
(NOVA program begins at 7:00 p.m. in the same meeting room)

April 15th 2011 Room - Sobey - SB 255
Our guest speaker will be Taro Sato whose topic is "Gone with the Wind: What Scarlett O'Hara Has Been Hiding about Galaxies"

May 20th 2011 - Location to be announced
At this meeting Paul Heath will discuss "Extra-Solar planets"

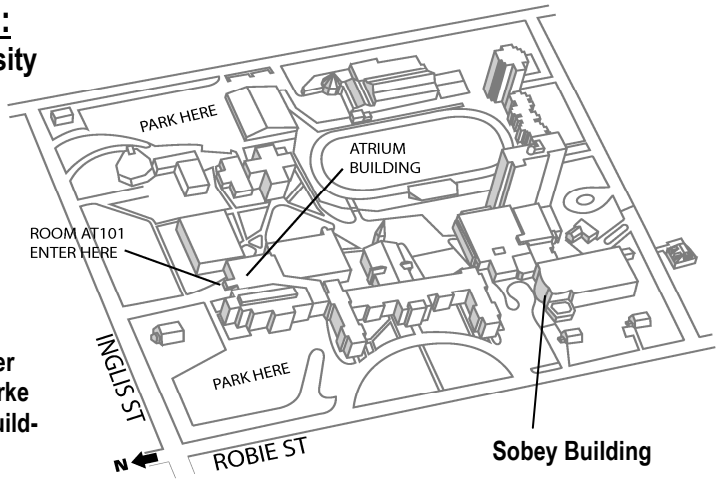
June 17th 2011 - Location to be announced
A regular meeting - speaker and topic to be announced

[The content of all meetings is subject to change]

Meeting Location:

Saint Mary's University

Atrium Building
Room AT 101



The Atrium is located in front of the Patrick Power Library, between the Burke Building and Science Building.

Meetings are usually held on the third Friday of the month, except for the months of July and August, when there are no meetings.

The Nova program (an introductory course in astronomy) starts one hour before the main meeting, in the main meeting room.

Executive meetings begin at 7:00 p.m., in room AT 306, and all members are welcome to attend.

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Nova East Update

Blair McDonald

It's that time again; your Nova East Committee has been hard at work planning for this year's hurricane! The very loose theme this year is: "Canadian contributions to space science and research". We also are planning quite a few workshops focusing on several aspects of amateur astronomy, ranging from building solar filters to telescope collimation.

This year we open the event with talk from Dr. James Drummond, of Dalhousie University, about the Canadian contributions to an upcoming ESA-NASA Mars orbiter, scheduled to launch in 2016.

Other speakers are our own Quinn Smith (How High is the Sky?), Paul Heath (Extra Solar Planets) and last, but certainly not least, Dr. Roy Bishop on the physics of a rainbow.

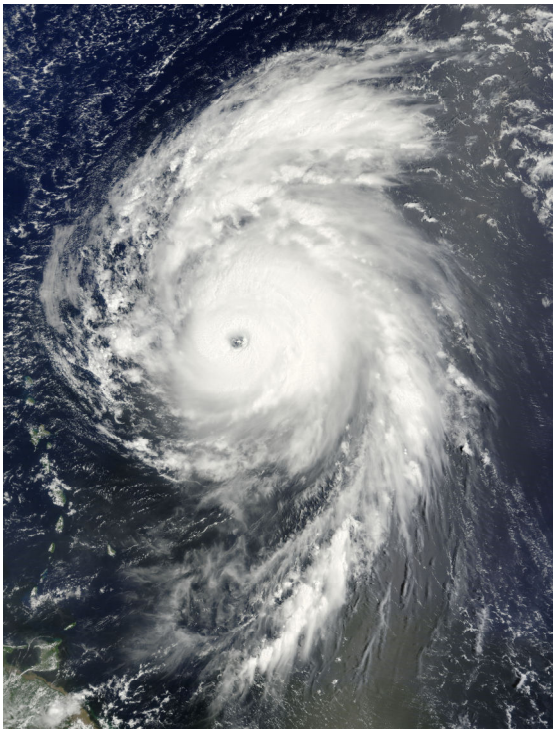
Workshops will be held on telescope collimation (Tony McGrath), solar observing (Karl Penny), lunar observing (our resident lunatic Dave Chapman), the making of a solar filters (Quinn Smith) and image processing (Blair MacDonald). A nature walk, tidal bore tour, night sky tour and a tour of the St. Croix Observatory round out the event.

The dates for this year's event are August 26th to August 28th (unless interrupted by a passing hurricane) and as usual we have some great door prizes.

The agenda is now up on the Nova East web site and the registration form will be online as soon as the park sets its camping rates for this year. Register early to ensure your t-shirt and reserve one of the choice camping spots.

From your friendly neighbourhood Nova East Committee.

http://halifax.rasc.ca/ne/

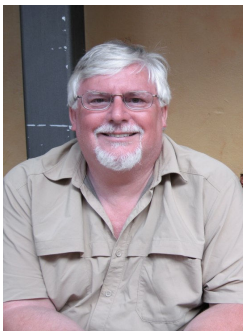


Front Page Photo

Dave Chapman

Technical stuff:

Canon XSi with in-camera long-exposure "dark" correction (sorry Blair!), Canon 17-85 EFS lens (set at 17 mm, manual focus, image stabilization off), ISO 1600 (high-ISO noise reduction off), 5 minutes on MusicBox EQ mount (mounted for southern hemisphere use), location Mount Cook Alpine Village, New Zealand, SQM reading 21.3 magnitudes/square arcsecond. Crux, Coalsack and Milky Way at upper left, Canopus at upper right, South Celestial Pole somewhere in the middle.



HALIFAX CENTRE

Nova Notes: The Newsletter of the Halifax Centre of the RASC

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The opinions expressed herein are not necessarily those of the Halifax Centre.
Articles on any aspect of Astronomy and Allied Sciences will be considered for publication.

Human Voyages to Mars? Forget It!

Dr Roy Bishop

I have experienced the space age from the beginning. In 1957 I was a university engineering student when Sputnik 1 astounded the world. Half a century ago I watched J.F. Kennedy's inauguration on television (black & white), and later that long-ago spring I heard his challenge to go to the Moon.

In 1972 I was sufficiently enthralled by the unprecedented daring and historic significance of Apollo to take my 9-year-old son to Florida to witness the most spectacular of all space events of that century, the nighttime launch of the last Moon flight, Apollo 17.

But humans to Mars? That it is not going to happen for a very long time, for the following reasons:

1. Expense
I doubt that support can be found for the financial commitment required. Even the much less expensive Apollo program would never have occurred without the stress of the Cold War of those years, plus Kennedy's charisma.

2. Lack of public support
Few people have any appreciation of the size of the Solar System. For most people, going to Mars is not much different than going to the Moon, and "we've been there, done that". After the first Moon landing, the news media, reflecting waning public interest, gave much less coverage to subsequent lunar landings, with the exception of the Apollo 13 drama. The public and politicians would have to be onside for a decade or more to prepare for a voyage to Mars. I do not see that happening.

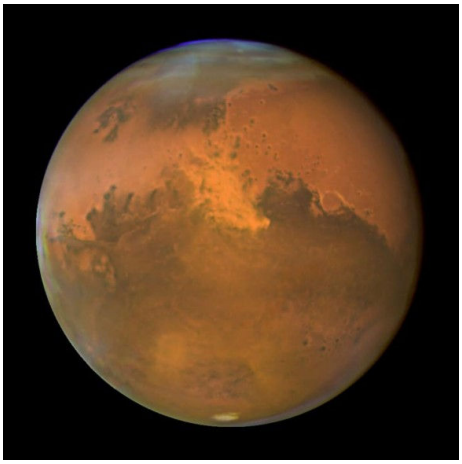
3. Robotic spacecraft
Humans are unlikely to accomplish much on Mars that cannot be done by robotic spacecraft far less expensively and at no risk to human lives.

Also, placing humans on Mars would irrevocably contaminate that planet, compromising any purported evidence that might be found for life on Mars. With continual advances in the capabilities of robotic spacecraft, human voyages beyond the Earth-Moon system make even less sense as the years go by.

4. Multiple risks
Compared to a lunar voyage, a voyage to Mars is far more risky, technologically, medically, and psychologically. A Mars journey takes much longer than a lunar visit (a couple of years, compared to a few days), and involves unprecedented communication delays (approaching half an hour, compared to a second or two during Apollo).

Astronauts are heavy, dirty, and tend to bump into things. They have to be fed, and provided with oxygen. They have to be kept warm, happy, and encased in pressurized chambers. They have to be protected from bursts of solar radiation, cosmic rays, molds, and harmful bacteria. They need exercise facilities, some level of medical care, and waste disposal.

After many months in weightless transit to Mars, it is questionable whether an astronaut encumbered with a heavy spacesuit and life support system could even cope with Martian gravity. And, unlike a robotic spacecraft, people want to come home, which adds tremendously to the cost, complexity, and risk of a Martian voyage. No small group of humans has ever had to face



conditions comparable to those that would be encountered on a Mars voyage.

Apollo astronauts could converse with people on Earth, and could put up with a lot of stress and discomfort knowing they would be home in a week.

What about the long-term prospect of humans migrating beyond Earth, of modifying the environment of Mars to make it suitable for life? Humans first have to learn to stop modifying the environment of Earth making it *less* suitable for life, and that will not happen until the environment trumps economic growth and population is stabilized.

It is nearly 40 years since Gene Cernan stepped back into the Apollo 17 lunar lander. It might be another 40 years before anyone returns to the Moon. Travel to Mars? Forget it. It will not happen in the lifetime of anyone reading this.

February Meeting Report

Chris Young

The Centre President, Richard Vanderberg, opened the meeting welcoming the 51 people attending, which included 11 guests. A number of the visitors were Richard's astronomy students who were given a tour of the BGO by Dave Lane after the meeting.

A warm welcome was extended to our special visitor, Kathryn Gray, who recently discovered a supernova. Councillor Sean Dzafovic presented NOVA Certificates to John Higgins and Graham Rose who had successfully completed the NOVA Program.

Richard then introduced the speaker for the evening, Dave Lane, who gave a presentation on "Amateur Variable Star Research at the Abbey Ridge Observatory (ARO)"

Dave said that his goal in building his observatory was to be able to make contributions to scientific research and to do this in a time efficient manner. He achieved this by automating all activities of the observatory, data collection and analysis. The observatory is remote controlled, although he is limited to doing this within a 100 km range of home in case something goes astray (for domestic reasons!).

Full automation involves controlling the dome, cloud and weather sensors, programming the Celestron C14 Schmidt Cassegrain for targets, and collecting and processing the night's data, (which is an enormous time saver).

Setting up the observatory in 2002 presented many challenges which Dave had to overcome. Since that time however, all equipment, controls and compatible software are now available "off the shelf". Dave has used the ARO for supernova searches, to study variable stars and for various research work with Dan Majaess and Dave Turner of Saint Mary's University.

Dave and the ARO have been involved with the AAVSO, along with other observatories around the world, in observing programs to provide a fuller record of star behaviour.

Dave has recently become involved again in the search for supernova by providing images to Kathryn Gray who discovered a supernova in January of this year.

Dave is starting a new project with Rachid Ouyed on the search for Quark Nova – supernovae which go nova again. Others find the novae and Dave keeps an eye on them. Despite his own sophisticated setup Dave emphasized that amateurs can make a positive contribution to science by being involved in observing programs such as the AAVSO.

Further awareness of the effort Dave has put into his observatory only increases our respect for his skills and dedication. Have a further look at ***www.davelane.ca/aro/***

After Dave's presentation, Paul Gray spoke for a few minutes about his daughter Kathryn's invitation to attend the Starmus Festival and Astronomy Conference in the Canary Islands. Kathryn and her family have been invited to attend, complete with VIP passes (***ww.starmus.com***). Unfortunately their trip is not paid for and Paul is seeking sponsorship to assist with the trip.

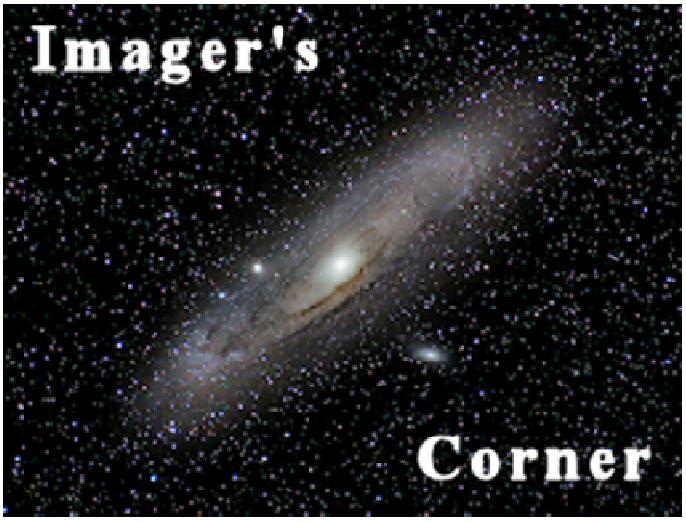
Kathryn took the opportunity to sell some fudge as a fund raiser (was delicious!). The New Brunswick Centre has donated $1,000.00 towards their attending this conference and upon return Paul will be providing presentations to the NB Centre. Hopefully we will have the opportunity to hear all about their experiences.

The meeting finished up with the sharing of refreshments and discussion. It was an excellent meeting.

Right: Kathryn Gray - The world's youngest Super Nova discoverer!

Above: Abby Ridge Observatory

Sean Dzafovic awarding Nova Program certificates: Above: John Higgins, below: Graham Rose



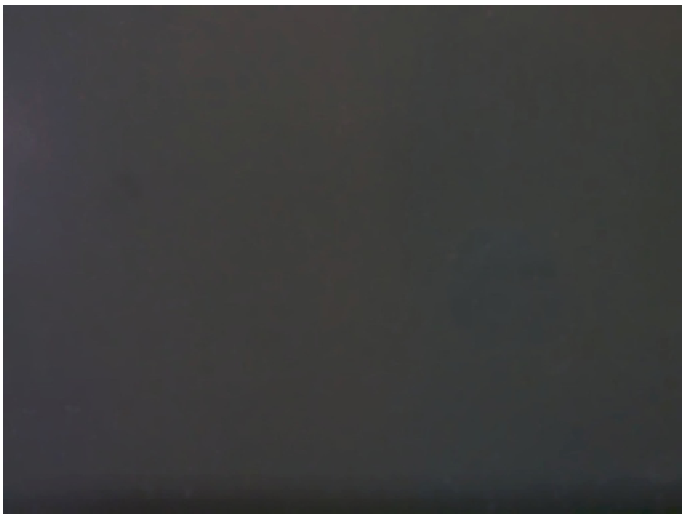
Blair MacDonald **Imager's Corner # 7**

This edition continues a group of Imager's Corner articles that will focus on a few techniques that are useful in processing astrophotos. Over the next several editions of Nova Notes I'll attempt to give a guide to image stretching, background correction, SIM processing and any other technique that I happen to find useful. All the techniques discussed will be useable with nothing more than a standard image processor that supports layers and masks. No special astro-image processor is required.

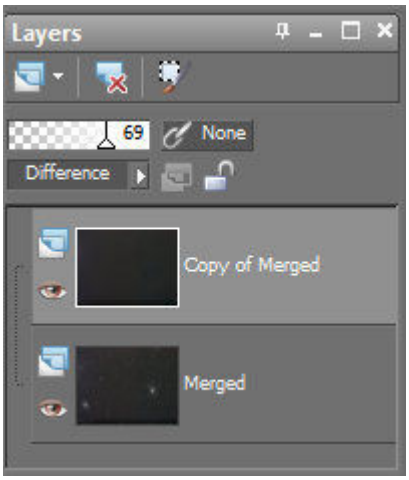
This edition will deal with background correction using processing to get that smooth dark sky look, even from the city. There are several common background problems that we can correct in processing, here we are correcting colour splotches and gradients.

Let's start with the M97 image below. There is a slight under correction from the flat field, a darker strip along the bottom and a purple blotch in the upper right edge.

The first thing to do is to remove the gradient and colour blotches. The first step is to duplicate the layer and clone out the galaxies and any bright stars. This will take a while so have some patience as getting this step right has a big impact on the final result. Next use a median filter with a radius much larger than the remaining stars (10 to 30) to remove the remaining stars in the image. Optionally if you don't get a smooth result apply a Gaussian blur, but if you've done a good job cloning out the bright stars and DSO's you should not have to use further blurring. This gives a layer that has no image detail, but contains the colour spots and gradient as shown below.



Now set the combine mode of this layer to difference and adjust the opacity to get the result you want. If you leave the opacity at 100% the background will be zero and you will clip some faint data. If you make the layer too transparent then the resultant image will be under corrected. The layer stack is shown below.



The resulting image when the layers are combined is free from the colour blobs and gradient as shown below.

Remember, this column will be based on your questions so keep them coming. You can send them to the list at ***hfxrasc@lists.rasc.ca*** or you can send them directly to me at ***b.macdonald@ns.sympatico.ca***. Please put "IC" as the first two letters in the topic so my email filters will sort the questions.

Blair MacDonald: M42 from an Urban Setting ***(I thought you might like to see a finished "gem" from Blair - Ed)***

Here is a bit of an experiment in urban imaging. This image was taken from light polluted third magnitude urban skies To negate the effects of light pollution, the ISO was reduced to allow for longer sub-exposures. The longer subs and aggressive noise reduction allowed a reasonable image to be captured.

Exposure: 66 minutes (33 X 2 minutes) for the faint areas and 8 minutes (16 X 30 seconds) for the core
ISO: 400 to accommodate the bright sky
Camera: Canon 350D DSLR
Optics: 8" f/4 Schmidt Newtonian Telescope
Location: Bedford Nova Scotia
Processing: Calibration, stacking, background noise reduction and initial star size reduction done with Images Plus . Both exposures were combined using a LMS technique. Background correction and further noise reduction applied in Paint Shop Pro . The star colour was enhanced the resulting image was then sharpened and resized for this web page.

Crossing to the "Dark Side"

John McPhee

Sooner or later, most backyard astronomers think about capturing images of the objects they observe. It's hard not to have visions of the spectacular photos of nebulae, galaxies and planets that fill astronomy magazines, coffee table books and websites.

Master astrophotographer Blair Mac Donald held a four-hour workshop in February that demonstrated you'd better be prepared to do a lot of work to produce those celestial masterpieces. About 25 people attended Astrophotography: "Taking and Processing Images of the Night Sky" in the Atrium wing at Saint Mary's University.

Brian Giffin of Atlantic Photo Supply in Halifax provided door prizes, as well as the use of a Celestron Schmidt-Cassegrain telescope for demonstration purposes. The RASC and Saint Mary's University also sponsored the session.

Blair divides his presentation into four categories: Hardware, image acquisition, calibration and stacking, and post-processing. Due to limitations of space and my own understanding of the technical issues (particularly in the processing and post-processing stages), please consider this article as only a recap of Blair's presentation. For more details, go to ***http://halifax.rasc.ca/documents/AstroImagingWorkshop.pdf.***

Hardware:
The first decision a budding astrophotographer must make is what kind of camera to use. A typical digital single-lens reflex camera, like a Canon Rebel, can be attached to a telescopic eyepiece with a T-ring adapter. For wide-field shots of constellations or the moon, you can place your camera "piggyback" on the telescope tube or simply on a tripod.

For wide angle moon shots, get something interesting into the foreground. Blair showed us a lovely but simple shot of a sailboat and the moon.

Then there are the CCD cameras designed specifically for astrophotography. Be prepared to spend some bucks on these babies. High-end models by manufacturers such as SBig can run into thousands of dollars. CCD cameras have more sensitive sensor chips for maximum light-gathering and a built-in cooling system that reduces "noise" in long-exposure images.

Blair outlining some of the finer points

Whatever camera you use, you'll need a mount to put it on, one that can track the movement of the night sky caused by the Earth's rotation. Equatorial mounts are specifically designed for this capability, while fork mounts for scopes like Schmidt-Cassegrains (SCTs) require a wedge that allows latitude adjustment.

Also in the hardware department, most astrophotographers use some kind of guiding system, either an off-axis guider, or a guide scope, which Blair favours.

Image Acquisition:
You must manually polar align your equatorial or wedge-equipped fork mount first in order to keep a particular object in the camera viewfinder for long periods of time.

This is a complicated, time-consuming process that I've yet to attempt. It involves pointing the polar axis of your mount toward Polaris, the North Star. You then swing your telescope around to find a star as close to due south as possible. Using a specialized eyepiece called a reticle, which has lines across its field for precise alignment, adjust the position of your mount until that star stops "drifting" in the field. This is one of those things that require a first-hand demonstration and lots of practice.

Along with polar alignment, the other big challenge in image acquisition is focus. Blair recommends using a diffraction focussing mask, which is a piece of paper cut out in a very specific pattern that is placed over the objective lens of the telescope. This mask creates diffraction spikes on an out-of-focus star, which act as a guide to achieving sharp focus (go to ***http://astrojargon.net***).

If you use a DSLR, always shoot in "raw" using the manual mode. You'll have a lot more control in later processing of the image than if you shoot JPEGs. Other settings tips for DSLRs: Use "daylight" white balance; ISO between 800 and 1600; one-shot drive; and set your exposure to "bulb," which keeps the shutter open as long as you wish

The typical exposure time for astrophotography shots is between three and 10 minutes, Blair said. Sub-exposures however, can be combined in later processing to the equivalent of much long longer exposures. Use a test shot and your camera's histogram to determine the correct exposure.

Calibration and stacking:
The crucial challenge in DSLR shooting is eliminating noise, the extraneous electronic and light-related clutter created by long exposures. There are several different types of noise: signal, bias, photon, etc.

Don't use the noise reduction program available in many cameras. Instead, shoot dark frames, flat field frames,

dark field frames and master calibration frames, using the same exposure time as your imaging exposure. For example, a dark frame is taken with the lens cover on. By stacking these frames with your image frames later with software programs such as Photo Shop and Deep Sky stacker, you can remove noise and bring out detail in your original image.

Post-processing:
This stage of image tweaking is done entirely at the computer, using programs such as Photo Shop and Paint Shop Pro. The first step is using tools such as the "curves" function to obtain the best contrast for your image. But post-processing mostly involves stacking layers and blurred masks to bring out detail, increase the brightness of objects such as nebulae, and eliminating problems such as bloated stars in the background of your image.

Combining a blurred mask layer with other layers -- such as the original image, bright and dim versions -- is the high-tech equivalent of the old-fashioned dodging and burning technique people used in the darkroom. This process allows you to keep the detail in both the highlights and the shadow components of your image.

The dramatic results of post-processing can be in Blair's before and after section on the presentation website. The "before" photos have been calibrated and stacked but the final versions show much more detail and vibrancy.

And in the end, as Blair says, it's all about pretty pictures, However far you want to take the process and how much work you want to put into it, it's all a matter of taste.

If you want the best possible version of your image, it's not a hobby for those craving instant gratification. But when you see the impressive work produced by experts like Blair, you can see why so many people venture into "the dark side."

March Meeting Report

Chris Young

The Centre President , Richard Vanderberg, opened the meeting welcoming the 50 people in attendance, including 6 guests.

Mary Lou Whitehorn showed an animation of Carl Sagan encountering the Star Battleship Astrology – a series of story boards from Michael, an animator with Dreamworks, which you can view on his blogsite ***http://ninjerktsu.blogspot.com/*** . National has permission to use this for its Education and Public Outreach program. Good fun, have a look!

Wes Howie provided an update on the Saltscapes Show. We have been invited as guests to share a booth with Atlantic Photo Supply on April 29, 30 and May 1st. We can have a maximum of 2 RASC members in the booth at a time. APS will have Celestron and Skywatcher scopes in the booth and we will bring our usual Audio-Visual displays. Wes will post a request for volunteers on the list in the near future.

Our speaker for the evening was Pat Kelly, who gave a presentation on "The End of the World as We Know it."

Pat opened by stating that changes are always happening to the Earth and our Universe. Most changes, be they geological or atmospheric, proceed over a very long timetable although some can be measurable over a few human generations.

Pat's talk was inspired by the astrobiology book "The Life and Death of Planet Earth" by Ward and Brownlee written as a follow up to their "Rare Earth". The topic was, and is, sobering. Pat presented Carl Sagan's Cosmic Calendar (From Sagan' Cosmos Series) as a time scale. This calendar compresses the history of the Universe into 12 cosmic months with Earth being formed in September, first life forms in mid-November and all of human civilization in the last 90 seconds. Oh yes, and life will be gone from the planet 2 weeks after that!

We then followed the long, extreme and catastrophic events that produced the formation of our planet and provided conditions for life. We were reminded of those "rare" conditions that allowed life to form and evolve on our planet and how fragile these are. We were shown the key mechanisms of change to our planet – plate tectonics, the chemistry of our oceans and atmosphere, and our Sun.

Then we fast forwarded to find that global warming, ice ages, the formation of a new single super continent, along with changes to the chemistry of the oceans and atmosphere were all inevitable. This would lead to the end of all life. Not to mention that the Sun will enter the final stages of its life as a red dwarf and expand out past the orbit of the Earth consuming our planet. A collision with the Andromeda galaxy is also possible.

Just when it seemed things couldn't get worse, Pat noted that there are some wildcard situations such as gamma radiation from a stellar nova or an asteroid strike which could rush our demise. Did I mention that these scenarios were all well illustrated, some with film clips from doomsday movies?

Is there a way out? Pat suggests a multi-generation star ship to another world perhaps. ("an off site backup" Dave Lane was heard to say). Over all, a thorough and informative talk. Pat then took questions "...while there was still time.."

Mike Boschat wrapped up the meeting with a "What's Up" of current and upcoming night sky activity for us to watch for. Refreshments and some therapeutic discussion followed to end the evening.

SCO Report (March 4th 2011)

Tony McGrath

Despite some concern that the sky condition might be less than ideal, I could not resist the call of SCO. I had decided before lunch that SCO was on my agenda. The sky throughout the morning exhibited signs that pointed to good seeing conditions, and I wanted to get some more experience with my 80 mm refractor.

I arrived around 19:00 to a sky estimated to have a visual limiting magnitude of 6.4. The impact of SCO's dark skies when you first get out of the car after 30 minutes of highway glare is incredible. With the bright winter constellations high in the south, you just want to stand there and look up.

While I was setting set up, Kim Hebert and her husband Miller arrived from Greenwood. Kim, a native of Ontario, is posted to 14 Wing Greenwood, and is just starting to observe with a telescope. We talked for a little and then decided that we could look at some objects in the 80 mm and compare the view of the same object to that through the Centre's 440 mm Dob.

Dave Lane arrived and set to work lighting the warm-room furnace. As soon as this was done, Blair arrived with imaging on his mind. Dave, Kim and Miller volunteered to help carry some of Blair's equipment. Somehow Dave ended up lugging the most massive piece. When he set it down on the floor of the roll off roof observatory, he figured it had to weigh 60 pounds.

Mark Dryden arrived, and in contrast to the set up Blair was using, came armed with a small tabletop tripod and a wide field point and shoot camera.

The evening was cold, probably around -14c, and within short order everyone was engaged in observing activities. I started Kim and Miller with some views of Orion's sword in the 80mm, and then switched to the big Dob for a look at M42 (with and without an OIII filter). The filter provided considerable improvement in contrast, however it noticeably dimmed fainter areas of the nebula. I then set Kim to work trying to find M81 & M82 in the small refractor with a low power eyepiece. She picked them up in short order, and we then switched back to the Dob for a better view.

While I went looking for some double stars in the small refractor, Dave set the Dob so that M35 and NGC 2158 were in the eyepiece, and then gave Kim and Miller a galactic perspective on the two clusters. While only 0.5 degrees SW of M35 in the field of view, NGC 2158 is 10,000 light years further away, sitting at the edge of our galaxy.

At this point, the focuser in the Dob got cranky, and refused to move in response to turning the focus wheel. The trouble I think is a combination of a heavy 2" eyepiece, cold temperatures, and an old focuser. We developed a focusing procedure that worked, however I think the time may have come to replace the old focuser with a new unit.

By now, Blair had his equipment calibrated and was in pursuit of extragalactic photons. While I really have no idea what is involved in getting a mount like that up and running, I am sure it is a complex operation. At points when Dave and Blair were talking, it sounded as if they were using a different language.

Mark produced a number of neat wide field images with his small set up. I counted four big winter constellations in one of the shots. The weight of his entire set up would be measured in ounces, talk about portable! Mark also has plans to try focal imaging with his small camera and BIG telescope.

I soldiered on for a little while with the double stars Alpha Geminorum (Castor) and Iota Cancri. With the telescope operating at 80x, Castor was clearly double, however it was not cleanly spilt. That took the 5mm which produced 112x. The stars where blue white and appeared almost equal in magnitude. Iota Cancri worked out best at 40x, and the color of the stars remind me why this pair is often referred to as the Spring Alberio.

After an enjoyable evening, by 23:00 I was cold soaked, and thought it best to pack up. Blair and Mark carried on. Perhaps we will see some of the results of their work on the list in the future.

Photo: Roy Bishop
The SCO in summer—much warmer!

Roy Bishop: Seven Crows
February 17, 2011 5:43 p.m.
Canon XTi photo, ISO 100, 1/160 s, f/5, 150 mm,

One crow sorrow,
Two crows joy,
Three crows a letter,
Four crows a boy;
Five crows silver,
Six crows gold,
Seven crows a secret
Never to be told.

Matt Nightingale: M55, M66

Tuesday Feb 1st 79 minutes total exposure time.

It was a mix of 60s, 90s, 120s, 180s and 240s exposures as I was playing with the exposure time that I could get away with without too much star elongation.

I think some sort of guide camera might be required soon so that I can increase the exposure time.

My camera battery died before I got a chance to take any dark frames last night, so I'm hoping to improve the shot a bit yet and maybe add another hour or two's worth of data.

Cosmic Debris

Odds and Sods from the World of Astronomy and Cosmology.

Author: Dr. Tony Phillips | Credit: Science@NASA March 2, 2011:

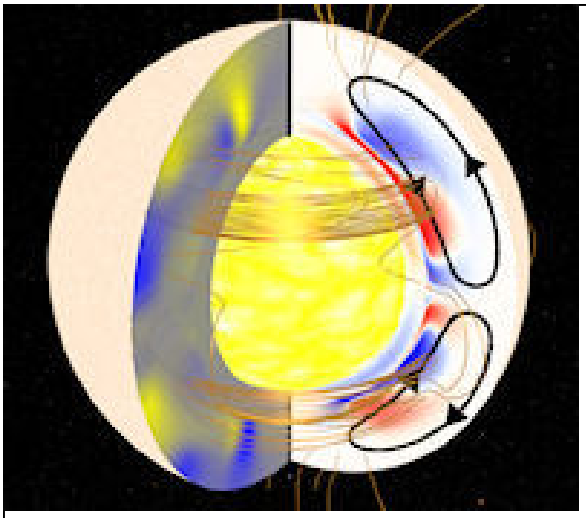
In 2008-2009, sunspots almost completely disappeared for two years. Solar activity dropped to hundred-year lows; Earth's upper atmosphere cooled and collapsed; the sun's magnetic field weakened, allowing cosmic rays to penetrate the Solar System in record numbers. It was a big event, and solar physicists openly wondered, where have all the sunspots gone?

Now they know. An answer is being published in the March 3rd edition of Nature.

"Plasma currents deep inside the sun interfered with the formation of sunspots and prolonged solar minimum," says lead author Dibyendu Nandi of the Indian Institute of Science Education and Research in Kolkata. "Our conclusions are based on a new computer model of the sun's interior."

For years, solar physicists have recognized the importance of the sun's "Great Conveyor Belt." A vast system of plasma currents called 'meridional flows' (akin to ocean currents on Earth) travel along the sun's surface, plunge inward around the poles, and pop up again near the sun's equator. These looping currents play a key role in the 11-year solar cycle. When sunspots begin to decay, surface currents sweep up their magnetic remains and pull them down inside the star; 300,000 km below the surface, the sun's magnetic dynamo amplifies the decaying magnetic fields.

Re-animated sunspots become buoyant and bob up to the surface like a cork in water—voila! A new solar cycle is born. ***(continued on page 12)***



In this artistic cutaway view of the sun, the Great Conveyor Belt appears as a set of black loops connecting the stellar surface to the interior. Credit: Andrés Muñoz-Jaramillo of the Harvard CfA.

For the first time, Nandi's team believes they have developed a computer model that gets the physics right for all three aspects of this process--the magnetic dynamo, the conveyor belt, and the buoyant evolution of sunspot magnetic fields.

"According to our model, the trouble with sunspots actually began in back in the late 1990s during the upswing of Solar Cycle 23," says co-author Andrés Muñoz-Jaramillo of the Harvard-Smithsonian Center for Astrophysics. "At that time, the conveyor belt sped up."

The fast-moving belt rapidly dragged sunspot corpses down to sun's inner dynamo for amplification. At first glance, this might seem to boost sunspot production, but no. When the remains of old sunspots reached the dynamo, they rode the belt through the amplification zone too hastily for full re-animation. Sunspot production was stunted.

Later, in the 2000s, according to the model, the Conveyor Belt slowed down again, allowing magnetic fields to spend more time in the amplification zone, but the damage was already done. New sunspots were in short supply. Adding insult to injury, the slow moving belt did little to assist re-animated sunspots on their journey back to the surface, delaying the onset of Solar Cycle 24.

"The stage was set for the deepest solar minimum in a century," says co-author Petrus Martens of the Montana State University Department of Physics.

Colleagues and supporters of the team are calling the new model a significant advance.

"Understanding and predicting solar minimum is something we've never been able to do before — and it turns out to be very important," says Lika Guhathakurta of NASA's Heliophysics Division in Washington, DC.

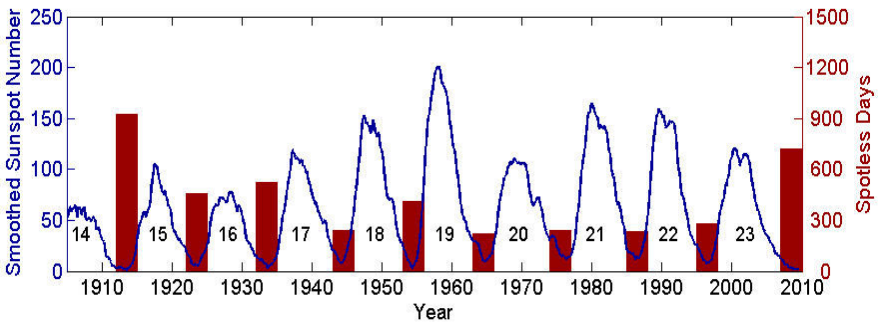
While Solar Max is relatively brief, lasting a few years punctuated by episodes of violent flaring, over and done in days, Solar Minimum can grind on for many years. The famous Maunder Minimum of the 17th century lasted 70 years and coincided with the deepest part of Europe's Little Ice Age. Researchers are still struggling to understand the connection.

One thing is clear: During long minima, strange things happen. In 2008-2009, the Sun's global magnetic field weakened and the solar wind subsided. Cosmic rays normally held at bay by the sun's windy magnetism surged into the inner solar system. During the deepest solar minimum in a century, ironically, space became a more dangerous place to travel. At the same time, the heating action of UV rays normally provided by sunspots was absent, so Earth's upper atmosphere began to cool and collapse. Space junk stopped decaying as rapidly as usual and started accumulating in Earth orbit. And so on….

Nandi notes that their new computer model explained not only the absence of sunspots but also the sun's weakened magnetic field in 08-09. "It's confirmation that we're on the right track."

Next step: NASA's Solar Dynamics Observatory (SDO) can measure the motions of the sun's conveyor belt—not just on the surface but deep inside, too. The technique is called helioseismology; it reveals the sun's interior in much the same way that an ultrasound works on a pregnant woman. By plugging SDO's high-quality data into the computer model, the researchers might be able to predict how future solar minima will unfold. SDO is just getting started, however, so forecasts will have to wait.

Indeed, much work remains to be done, but, says Guhathakurta, "finally, we may be cracking the mystery of the spotless sun."



Sunspot cycles over the last century. The blue curve shows the cyclic variation in the number of sunspots. Red bars show the cumulative number of sunspot-less days. The minimum of sunspot cycle 23 was the longest in the space age with the largest number of spotless days. Credit: Dibyendu Nandi et al.